MONTHLY WEATHER REVIEW,

JUNE, 1877.

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

The present REVIEW for the month of June depends upon all data received up to the 14th of July from the Canadian Meteorological Service, the United States Signal Service and Voluntary Observers, the Army Post Surgeons and the United States Navy. The most interesting features have been: First, The high temperatures in California; Second, The heavy rains in the Mississippi and Missouri valleys; Third, The numerous severe local storms; and, Fourth, The general diminution of grasshoppers and locusts.

BAROMETRIC PRESSURE.

In General.—The general distribution of barometric pressure for the month is shown by the isobars on chart No. II, from which it will be seen that the highest pressure has been off the South Atlantic coast, whence it diminished very regularly northwestward towards Dakota, in the northern part of which Territory it is probable that the lowest monthly average will be found. The isobar of 29.80, as shown on this chart, agrees very closely in its position with those that obtained in the previous years, 1872 to 1876, inclusive. The pressure has been slightly lower at San Diego, Cal., and lower at Portland, Or., than in previous years.

Barometric Range.—The general range of the barometer over the whole country east of the Rocky Mountains was about 1.15 inch, as may be seen from the following table, which gives the maximum and minimum pressures that occur on the tri-daily maps near the centres of the respective areas of high and low barometer:

LOW AREAS.				HIGH AREAS.			
No.	Location.	Date.	Minimum Pressure.	No.	Location.	Date.	Maximum Pressure.
I	Manitoba	June 1st, 7:35 a. m.	29.35	I	South Atlantic coast	June 2nd, 7:35 a. m.	30.27
II	Ohio valley	June 5th, 4:35 p. m.	29.50	II	Cape Breton	June 8th, 7:35 a. m.	30.38
III	Lower Missouri valley	June 6th, 11 p. m.	29.23	III	Shreveport, La	June 10th, 7:35 a. m.	30.23
IV	Lake Erie	June 9th, 4:35 p. m.	29.42	IV	Cape Breton	June 12th, 7:35 a. m.	30.33
V	Lake Michigan	June 11th, 7:35 a. m.	29.74	V	Manitoba	June 19th, 7:35 a. m.	30.27
VI	Missouri valley	June 14th, 4:35 p. m.	29.00		Lake Superior	June 19th, 4:35 p. m.	
VII	Manitoba	June 17th, 4:35 p. m.	29.45	VI	East Gulf coast	June 20th, 7:35 a. m.	30.18
VIII	Cape Breton	June 22nd, 4:35 p. m.	29.27	VII	Upper Michigan	June 22nd, 7:35 a. m.	30.20
IX	Manitoba	June 23rd, 4:35 p. m.	29.35		Middle Atlantic States	June 23rd, 7:35 a. m.	30.21
X	Kansas	June 25th, 4:35 p. m.	29.50	VIII	Cape Breton	June 30th, 7:35 a. m.	30.21
XI	Lake Superior	June 30th, 11 p. m.	29.29				

The greatest local barometric ranges have been as follows: 0.91 at Bismarck and Escanaba; 0.92 at Breckenridge; 1.10 at Duluth; 1.02 at Marquette; 0.94 at North Platte.

The least local barometric ranges have been: 0.45 at Indianola, Shreveport and Montgomery; 0.43 at Vicksburg; 0.44 at St. Louis and Cairo; 0.38 at St. Marks; 0.36 at New Orleans and Mobile; 0.40 at Galveston and Jacksonville; 0.41 at Memphis.

Areas of High Pressure in General.—The areas of high pressure have as usual during the summer consisted principally of the encroachments upon the Gulf and Atlantic coasts of the general area of high pressure pre-

vailing over the Atlantic. The high pressure areas, due to the flow of cold, dry air southeastward from the Rocky Mountain region and British America, have been but very feebly marked—only two such areas, Nos. V and VII, are included in the following list:

No. I—Was central over the South Atlantic States during the 1st, and over the East Gulf States during the 2d, 3d and 4th, and over the eastern portion of the Gulf of Mexico on the 5th, by which time the pressure had diminished to 29.90, or less, but rose again on the 7th to 30.05, or more, and so continued over Florida and the South Atlantic coast until the 9th.

No. II.—Pressure rose on the 6th over Nova Scotia, with easterly winds, and continued rising during the 7th and 8th, but fell to 30.00 on the morning of the 10th.

No. III.—Pressure rose on the 9th in Texas, with northwest winds, which winds at that time prevailed over the Ohio region, northward to Manitoba. The area of highest barometer continued in Texas during the 10th, and extended slowly eastward to the Mississippi valley, where it remained during the 11th and 12th, after which it diminished slowly, with southerly winds.

No. IV.—Pressure increased during the 11th on the entire Atlantic coast, and especially with easterly winds in the Middle Atlantic States. North and east winds prevailed on the 12th at most of the coast stations, the isobars continued trending parallel to the Appalachian range, and pressure at 11 p. m., of the 12th, ranged between 30.20 in South Carolina and 30.30 at Cape Breton. The barometer fell during the 13th, but remained highest near Cape Hatteras during the 14th and 15th, after which it remained highest off the South Atlantic coast and over Florida until the 17th and 18th.

No. V.—In the rear of low barometer No. VII, pressure rose rapidly in Manitoba, where it was 29.74 at 7:35 a. m., of the 18th, but 30.27 at 7:35 a. m., of the 19th. This area of high pressure moved rapidly southeastward, and was central in the St. Lawrence valley at 7:35 a. m., of the 20th, and off the Middle Atlantic coast at 4:35 p. m.; it was immediately followed by low barometer No. VIII.

No. VI and VII.—Pressure was high at stations on the Gulf coast from 19th to 31st. On the 21st, immediately in the rear of low No. VIII, it rose rapidly over the Upper Lake region; on the 22nd, at 7:35 a. m., it was highest over Lake Superior; on the 23rd, 7:35 a. m., over Pennsylvania; on the 24th, 7:35 a. m., off Cape Hatteras. The pressure was high over the Southern States on the 25th, and over the eastern portion of the Gulf States, on the 26th, 7:35 a. m.; over the lower Missouri valley on 27th, 7:35 a. m., after which it diminished.

No. VIII.—Pressure rose on Middle and East Atlantic coast on the 28th, while, in the interior of the country, low barometer No. XI was developing; easterly winds prevailed at most of the Atlantic coast stations, and the highest pressure, which was at first central off the Middle and East Atlantic coast, was by 7:35 a. m., 30th, transferred to the South Atlantic coast, while the isobars continued trending parallel to the mountain ranges.

Areas of Low Pressure in General.—Eleven areas of low pressure are enumerated in the following list, of which nine were sufficiently definite to justify the charting of their tracks, as given on map No. I. In general, their paths lay considerably to the north of those charted in June, 1875 and 1876 and agree better with those charted in June 1873 and 1874. The areas of low pressure that have passed from the Rocky Mountains eastward, during the month of June, appear, in all cases, to have originated on the eastern slope. The principal depression that occurred on the Pacific slope was 29.75 inches on the 12th at San Francisco, which was accompanied by, and may have been due to, an extensive depression in Nevada, Colorado, Dakota and other portions of the Rocky Mountain region.

No. I.—This depression appears on the morning of the 1st central in Minnesota, and appears as a trough stretching north and south, lying between areas of cold northwest winds on the west and warm southerly winds on the east. It moved to the north-northeast until beyond our stations and then passed, during the 2nd and 3rd, eastward over Canada; it disappeared on the 4th over the Gulf of St. Lawrence. During these three days the prevailing low pressure in Canada and high pressure in the Southern States gave rise to steady south and west winds and numerous areas of local rains over the Lake region, the Middle and Eastern States.

No. II.—During the 3rd increasing southeast winds prevailed from Texas to Missouri, culminating during the night in local rain-storms in Indian Territory. On the morning of the 4th, the pressure was lowest in the Missouri valley, whither the winds tended during the rest of the day. The 4:35 p. m. map of the 4th shows rain-fall at nearly all stations between Minnesota and Indian Territory. Concerning the severer local storms occurring on that day at Mt. Carmel, Mattoon, Boonville, &c., see the appropriate chapter. The fall of the barometer appears to have been most decided on the eastern side of the low area, which accordingly moved due eastward between the regions of cold northerly and warm southerly winds that lay north and south of its track. Its centre was on the morning of the 5th in eastern Illinois, and on the

morning of the 6th in West Virginia, whence it stretched very slowly eastward until it disappeared, on the morning of the 7th, off the coast of New Jersey.

No. III.—This depression originated on the morning of the 5th in Dakota and Manitoba on the western edge of the extensive area of cool air that pressed southeastward in the rear of low barometer No. II. During the afternoon of the 5th, the barometric depression extended rapidly southward into Kansas, its centre remaining apparently in Dakota or possibly still further to the northward, but on the morning of the 6th it is judged to have been located in Nebraska, because in that region the opposing northwest and southeast winds were then prevailing. The southern end of the trough was, as is usual, rapidly closed up by the cold, northwest winds, which attained a velocity of 56 miles per hour at Dodge City, Kansas, at 4:35 p. m. of the 6th, and at 11 p. m. a very considerable and well-marked depression was central in Iowa, with brisk and high northwest winds in the Missouri valley. The depression now passed northeastward to Lake Superior, where it was central at 11 p. m. of the 7th, after which it disappeared. The heaviest rain-falls attending the progress of this low area were in the immediate Missouri valley, and occured during the prevalence of cold northwest winds, or just preceding the shifting of the winds to that quarter, and generally in rear of the principal area of low pressure.

No. IV.—Between the 6th, 11 p. m., and the 7th, 11 p. m., the temperature fell 9° at Cheyenne, 15° at Denver, 9° at Santa Fe, 7° at Leavenworth, 6° at Shreveport, and similarly over the entire intermediate region, near the centre of which the opposing northwest and southeast winds continued to meet during the entire twenty-four hours. In this region originated storm No. IV, whose centre is placed in the northeastern corner of Indian Territory, at 11 p. m. of the 7th, at which time therefore it appears as the southernmost of a series of depressions, of which No III is also one. On the 8th, at 4:35 p. m., No. IV was central in northern Illinois; at 11 p. m. in southwestern Michigan, and on the 9th, at 7:35 a. m., over Lake Huron. Heavy rains had accompanied its progress throughout the Gulf States, the Ohio valley, Missouri and Illinois. At Memphis nine inches had fallen up to 4:35 p. m. of the 8th, and four and a half inches more fell on the 9th before 7:35 a. m. Under these circumstances a decided fall of the barometer took place over Tennessee and Kentucky, and there is reason to assume that a small secondary depression moved northeastward nearly parallel with the principal one, and was, during the night of the 9th, united therewith in the northern portion of Canada. During the afternoon and evening of the 9th, these depressions being then in the Lower Lake region, there were experienced on Lakes Erie and Ontario heavy southwest winds, with rain. On the 10th this depression moved northeastward down the St. Lawrence valley, and disappeared over the Gulf.

No. V.—During the morning of the 10th the pressure rose at most stations east of the Rocky Mountains; but by 4:35 p. m. a slight depression had become manifest in Illinois and eastern Iowa, extending thence southwestward to northern Texas. This slight depression moved slowly northeastward and disappeared by midnight of the 11th over Lake Superior. It was not marked by the prevalence of any extensive area of high winds or of heavy rains.

No. VI.—The pressure continued low from the Upper Lake region westward to the Rocky Mountains during the 12th and 13th, and was also quite low in California. It fell slowly in Texas and at most of the Rocky Mountain stations. It was high, but falling, during the 12th in Oregon; where, on the 13th, at 4:35 p. m., it was 29.96, after which it rose somewhat. It appears, therefore, that a very general depression existed during these days over a greater part of the region lying between the Missouri, the Mississippi and the Pacific, and that it originated in this region seems the most plausible assumption. On the 14th, at 4:35 p. m., we have the first reports of northerly winds in Dakota and Wyoming, and may place the centre of greatest barometric depression in northern Nebraska. A rapid rise in pressure now occurred to the northward, with colder northerly winds, and the depression stretched, as usual, northeast and southwestward into a trough which, on the 15th, at 4:35 p. m., extended from Missouri northeastward over Lake Huron and beyond; its centre is at this time placed at Mackinac. At 11 p. m. this trough evidently extended from Missouri to the mouth of the St. Lawrence, being, as usual, the boundary between the areas of northerly and southerly winds. During the 16th this depression broke up into several ill-defined areas, of which the principal one was over the Gulf of St. Lawrence, where the pressure continued low during the 17th.

No. VII.—This depression appears first on the afternoon of the 16th in western Dakota, and was, apparently, at that time the southern end of a trough trending still further northwestward. At 4:35 p. m., the temperature had risen remarkably in Indian Territory, Kansas, Nebraska, Colorado and Utah. At 11 p. m., high temperatures prevailed in Minnesota, Iowa and Nebraska, and the winds were uniformly directed towards western Dakota. On the 17th, at 7:35 a. m., high temperatures prevailed from Kansas northward to Manitoba. The pressure had very generally fallen; southeast rather than southerly winds prevailed, and several local rain or hail-storms were reported. The southern end of the barometric trough, that was evidently still forming, was probably at this time in Manitoba, but at 4:35 p. m. the 17th, it can be located, with certainty, in northeastern Dakota; it was, at 11 p. m., in northern Minnesota; on the 18th, at 7:35

a. m., the trough stretched from eastern Nebraska to Lake Superior, but at 4:35 p. m. the pressure had rapidly filled up on its western sides, where an area of high barometer then appeared, and the low pressure, like its predecessor, stretched as a series of slight depressions from Kansas to Lake Huron. At 11 p. m. of the 18th, the isobar of 29.90 extended from Indian Territory to the Gulf of St. Lawrence, very much as was the case at 11 p. m. of the 15th, and the only low pressures were in northern Canada, beyond the limit of our stations, where, however, they apparently continued to progress eastward, giving rise to the low pressure that prevailed over Newfoundland on the 19th.

No. VIII.—The barometer was low on the 19th over California, Oregon and Rocky Mountain stations, while high pressure No. VII was over the Lake region. Low pressure No. VIII appears to have been central in western Dakota at 11 p. m. on the night of the 19th; commenced to move slowly to the ENE. on the 20th, and, at 11 p. m., was central north of Lake Huron. The northerly winds that followed it were accompanied by extensive heavy rains, which, on the same date, prevailed over lower Michigan, Wisconsin, Illinois, Iowa and the lower Missouri valley. This region of heavy rains lay in the rear of and on the SW. side of the region of lowest pressure, but on the northern limit of the region of fresh southerly winds. The succeeding weather map, June 21st, 7:35 a. m., shows that this area of rains had moved eastward to the Lower Lake region, while the area of low pressure had extended rapidly southward, and during the rest of the day covered the Middle and East Atlantic States. The 7:35 a. m. report of the 22nd shows that heavy rains had fallen over the Middle Atlantic States wherever the cooler NW. winds had replaced the warm southerly winds of the preceding morning, and therefore under circumstances precisely similar to those that accompanied the heavy rain of 11 p. m. of the 20th in Iowa, Wisconsin, &c. After 11 p. m. of the 21st the pressure fell rapidly over Maine and the Canadian Provinces, and the area of lowest pressure disappeared over the Gulf of St. Lawrence on the 22nd.

No. IX and X.—This extensive but indefinite area of low pressure No. IX was developed on the 22d, over the Rocky Mountain region, and on the 23rd extended southward from Manitoba into the Missouri valley. During the 23rd, 24th and 25th, the central lowest pressure probably moved eastward through Northern Canada, while there was visible within the region covered by our western stations only the southern extremity of the extensive trough of low pressure; near the southern extremity of this trough there originated on the 24th, a series of severe local storms, which are fully described on p. 7. During the 26th, the area of falling barometer extended eastward into the Middle States, and the numerous local rains and storms that prevailed over the Ohio valley, the Northwest and Lake region, were followed by a decided rise in pressure and cooler northwest winds. At 11 p. m., on the 26th, the lowest pressure was over Penn., and at 7:35 a. m. on the 27th, it was off the Middle Atlantic coast. At this time pressure was nearly uniformly lowest, although not very low, from the Middle Atlantic coast westward to Kansas, and during the rest of the day, a slight depression developed over the Middle Atlantic States, while the pressure rose both northeast and northwestward. On the 28th, at 4:35 and 11 p. m., a slight depression existed off the South Atlantic coast, which is numbered X in our list. The tracks of Nos. IX and X are too indefinite to admit of being charted.

No. XI.—The pressure was low in Oregon at 4:35 and 11 p. m. of the 27th, which depression was apparently but a part of that which then prevailed over most of the Rocky Mountain stations. The central lowest pressure was probably at 11 p. m. either in Wyoming or Montana, whence it moved eastward over Dakota and Minnesota and Lake Superior, as a well-marked area, preceeded by very warm southerly winds and followed by high northwest winds. At 11 p. m. of the 30th it was probably central over the northeastern portion of Lake Superior. The further history of this storm-centre belongs to July, as it disappeared on the 3rd over the Gulf of St. Lawrence.

Vessels Experiencing Storms at Sea.—1st, N. 49° 29′, W. 6° 0′, strong WSW. gale and heavy swell. 2d, N. 48° 47′, W. 28° 7′, strong NW. gale and high sea; N. 49° 27′, W. 9° 12′, strong SW. gale and heavy rain. 9th, N. 43° 37′, W. 47° 12′, strong N. and NNW. gale. 12th, east coast of Mexico, severe norther.

TEMPERATURE OF THE AIR.

In General.—The general distribution of temperature for the month is shown by the isotherms on chart No. II. A comparison with the averages for June during the past 7 years shows that the temperatures have been slightly above the average in New England and the South Atlantic States, but slightly below in the St. Lawrence valley, Upper Lake region, Ohio valley and Tennessee and the Lower Missouri valley, and decidedly below in the Upper Mississippi and Missouri valleys and in Minnesota.

Monthly Mean Temperatures, at special points, have been as follows: Mt. Washington, 44°.8; Pike's Peak, 28°.1; Virginia City, 52.°8

Maximum and Minimum Temperatures.—Maximum temperatures above 95° were reported as follows: 96°, Corsicana, Nashville, Shreveport, Washington; 97°, Denison, Augusta, Tybee Island, Wilmington;

98°, St. Marks; 99°, Jacksonville, Norfolk, Savannah; 100°, Mobile, Charleston, Montgomery; 101°, San Antonio; 108°, Rio Grande. Minimum temperatures below 35°: 34°, Bismarck, North Platte; 33°, Santa Fe; 32°, Cheyenne; 30°, Breckenridge; 25°, Mt. Washington; 10°, Pike's Peak. The interval from Friday, June 8th, to Tuesday, June 12th, was marked by excessively high temperatures in southern California—said to have been the highest, in fact, that have been reported since the memorable summer of 1859, when the maximum temperatures for June were, Fort Yuma, 117°, San Diego, 102°, and later in the summer of the same year there were reported, at San Bernardino, 133°, the old placer belt, 117° to 119°. During the present June the maxima have been: Yuma, A. T., 114°, Stanwix, 110°, Maricopa Wells, 110°, Wickenburg, 108°, Camp Verde, 104°, Campo, Tucson, 102°, Phoenix and Florence, 100°, on the 12th; San Francisco, 92°, 11th; San Diego, 93°, 9th; Los Angeles, 101°, 8th; 103°, 9th; 104°, 10th; 112°, 11th; Cajon Rancho, 112°, 9th; 107°, 10th; Holloway's, 105°, 11th; Spring Valley, 111 to 122, 11th; Campo, 101°, 11th; Stanwix, 108, 11th.

Ranges of Temperatures.—The largest diurnal ranges have been: 37°, St. Marks, 2d; 38°, Bismarck, 9th, Virginia City, 15th, and Burlington, Vt., 24th; 39°, Breckenridge, 22d; 40°, Cheyenne, 16th and 27th, Santa Fe, 7th; 41°, Mason, Tex., —; 44°, Denver, 27th. The largest monthly ranges have been: 50°, Dubuque and Omaha; 51°, Alpena; 53°, Bismarck; 55°, Cheyenne; 56°, Denver, Dodge City and Mason; 57°, Santa Fe; 59°, Breckenridge; 61°, North Platte.

Frosts were observed as follows: 1st, Vermont. 2d, Wyoming Ter. 8th, Iowa, Missouri and Texas. 9th, Dakota, Iowa, Minnesota and Nebraska. 10th, Iowa, Texas, (severe,) Minnesota and Nebraska. 11th, New York, Ohio and Virginia. 12th, Minnesota and Vermont. 20th, Maine. 23d, Maine, Michigan, New York, Ohio and Vermont. 30th, entire month at Summit, Colorado.

The formation of *Ice*, rather than frosts, was reported from Rockford, Iowa, on the 10th; Moorehead, Minn., 9th; thin coating of ice formed upon the barrels of water at Camp Sheridan, Neb., 10th, morning; on the 9th, ice formed at Cheyenne and North Platte.

PRECIPITATION.

In General.—The general distribution of rain for June is shown on chart No. III, from which it will be seen that the region of largest rain-fall extends from western Tennessee to Indian Territory and thence northward over Illinois, Iowa and the lower portion of the Ohio valley. Rather heavy rains have also fallen at a few points on the South Atlantic coast. Light rains have fallen in Canada, and almost none in California. This distribution of rain over the country east of the Rocky Mountains may be described as being almost directly the inverse of the distribution for June, 1874. The table of comparative values given on chart No. III shows a very large excess of rain in the South Atlantic States, Tennessee, Upper Mississippi valley, Lower Missouri valley and Minnesota.

Special Heavy Rains.—The following are the most notable cases of heavy rains that have been reported: On the 1st and 2nd at St. Louis 3.32 inches. 4th, Denison, Texas, 2 inches in twenty minutes. 6th, Kingston, R. I., estimated 10 inches; 6th and 7th, New London, 4.37; Independence, Kansas, 2.62 inches in 40 minutes. 7th and 8th, Leavenworth, 3.83. 8th and 9th, Memphis, 13.37. 10th, 11th and 12th, Kittyhawk, 7.33. 11th and 12th, Cape Hatteras, 5.85; Wilmington, 4.86. 11th, 12th and 13th, Smithville, N. C., 4.46; and Jacksonville, 5.73. 12th, Savannah, 4.80; Cape Hatteras, 3.94; Charleston, 3.96. 12th and 13th, Tybee Island, 4.14. 14th, Mobile, 4.37. 19th, 20th and 21st, Keokuk, 3.63. 21st, 22nd and 23rd, St. Marks, 3.08. 29th, Breckenridge, 3.28; St. Paul, 3.48, (of which 2.41 fell in 1 hour.) 30th, Vevay, Ind., at the close of the remarkably violent storm a heavy shower, lasting five minutes, fell from an apparently cloudless sky, drops were of large size, and, as caught on a sheet of blotting paper, made circles 2½ inches in diameter. On the 8th and 9th the rain at Memphis was, at times, a steady pour at the rate of 4 inches per hour; on the same days remarkable rains took place at Helena, Ark.—where, from 2½ p. m. on the 7th to 2 p. m. on the 8th about 12 inches fell, one half of which was lost by the overflow of the gauge, and similarly from 11 p. m. of the 8th to 7 a. m. of the 9th over 11 (and possibly 13) inches fell, one-half being lost by overflow. The entire surrounding country was of course flooded with water in a manner never before known.

Small Monthly Rain-falls.—The following stations report less than 0.5 of an inch; the stations in California and Arizona generally report rain-fall zero or inappreciable; Griffin, Texas, 0.49 inch; Santa Fé 0 13.

Large Monthly Rain-falls.—Rain-falls to the amount of 10 inches or more, were reported as follows: Charleston, S. C., 10.31; Kittyhawk, 10.97; Leavenworth, 10.00; Memphis, 18.16; Fort Snelling, Minn., 10.69; St. Mary's Ga., 11.39; Fort Madison, Iowa, 11.56; Springfield, Mo., 15.20; Helena, Ark., (23?); Urbana, O., 12.34; Bellefontaine, O., 10.91; Carthagena, O., 17.33; Louisburg, O., 10.60; Jackson, Tenn., 12.01.

Droughts.—Droughts, injurious to vegetation, have been reported as follows; Connecticut, drought, lasting six weeks, ended on the 8th. Maine, Gardner, May and June both very dry; severe drought now prevails. Michigan, Northport, vegetation only partially recovered from the drought of May. North Carolina, Attaway, severe drought ended on the 9th. Vermont, West Charlotte, severe drought much relieved by rain of the 16th and 30th; hay crops will be one-third of the average. Florida, Pensacola, no rains for a month.

Hail-storms.—Hail storms have been reported as follows: 1st, Wis.; 2nd, Kan., Mt. Washington; 4th, Kan.; 5th, Neb., Pike's Peak; 6th, Kan., Neb.; 7th, Tenn., Ind.; 9th, Ill., Mo.; 10th, Dak., Mo., Pike's Peak; 11th, Ill, Ind., Kan., Mich., Dak.; 12th, Iowa, Dak., Mich.; 13th, Ind.; 14th, Neb., N. Y.; 15th, Iowa, Neb.; 16th, N. Y., Pike's Peak; 17th, Iowa; 18th, Pike's Peak; 19th, Iowa, Neb.; 20th, Ohio, Fla.; 22nd, Vt.; 23rd, Kan., Neb.; 24th, Neb.; 25th, Neb., Iowa, Ind.; 26th, Kan., N. C.; 28th, Nev., W. Va., (near Morgantown, breadth of storm one-half to three-quarters of a mile;) 29th, Minn., Wis., Neb., N. Y.; 30th, Ind., Neb., N. Y., Ohio, Wis.

Large Hail-stones.—30th, Genoa, Neb., diameter from half inch to 1 inch; 29th, Nilesville, Wis., diameter half inch, width of storm-track 10 miles; 25th, Dubuque, Iowa, large as quails' eggs; 11th, terriffic hail, Leroy, Ill.; 30th, Fort Wayne, Ind., flat disks half inch diameter.

Snow fall.—At Summit, Col., the observer reports snow prevalent in first part of the month, and all traveling done on snow shoes. On Pike's Peak snow fell on the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 11th, 29th. On Mt. Washington sleet was reported on the 22nd.

Rainy Days.—The number of days on which rain has fallen, as recorded by Signal Service observers, ranges as follows: New England, 11 to 20 days; Middle Atlantic, 10 to 17; South Atlantic, 10 to 16; East Gulf, 9 to 13; West Gulf, 7 to 14; Tennessee and Ohio valley, 13 to 20; Lower Missouri, 15 to 22; Upper Mississippi, 11 to 19; Upper Lake region, 10 to 20; Lower Lake region, 14 to 20; Rocky Mountain stations, 5 to 7.

Cloudy Days.—The number of cloudy days reported during the month, by Voluntary Observers and Army Surgeons, ranges about as follows: New England, 7 to 15; Middle Atlantic States, 4 to 15; South Atlantic States, 6 to 12; East Gulf States, 8 to 18; West Gulf States, 0 to 8; Tennessee and Ohio valley, 7 to 14; Lower Missouri valley, 2 or 3; Upper Mississippi valley, 5 to 12; Lake region, 5 to 17.

RELATIVE HUMIDITY.

The average relative humidity for the month ranges about as follows: New England, 61 to 79; Middle Atlantic States, 67 to 84; South Atlantic States, 70 to 80; East Gulf States, 65 to 80; West Gulf States, 61 to 74; Tennessee and Ohio valley, 68 to 72; Lower Missouri valley, 68 to 71; Upper Mississippi valley, 64 to 71; Upper Lakes, 67 to 74; Lower Lakes, 65 to 74; San Francisco, 66. High stations, uncorrected for altitude, report as follows: Mount Washington, 83; Cheyenne, 38; Salt Lake City, 30; Santa Fe, 20; Pike's Peak, 76; North Platte, 54; Dodge City, 66; Virginia City, 44.

WINDS.

In General.—The prevailing winds at Signal Service stations are shown by arrows on chart No. II, from which it will be seen that, with scarcely an exception, south and southwest winds have been most numerous at all stations east of the Rocky Mountain slope. Northerly winds have prevailed in Oregon and California.

Total Movements.—The largest total movements are as follows: Breckenridge, 9, 205 miles; Cape Hatteras, 9,463; Cape Lookout; 10,378; Dodge City, 9,940; Indianola, 10,735; Kitty Hawk, 9,184; North Platte, 10,712; Pike's Peak, 18,894.

Smallest Movements.—Augusta, 2,418; Lynchburg, 2,446; Nashville, 2,891; Shreveport, 3,099.

Highest Velocities in miles per hour, have been: 6th, Dodge City, 60; — Indianola, 60; 18th and 25th, Indianapolis, 50; 25th, Chicago, 50; 19th, Mount Washington, 72; 22d, North Platte, 86; Pike's Peak, 87; 27th, Fort Whipple, 96.

Local Storms, Tornadoes, &c., have been reported as follows: unless specially noted, it is to be understood that the following list of high winds include only local storms, and not such gales as prevailed simultaneously over a large region. 4th, Mt. Carmel, Ill., and Mattoon, Ill., 5:45 p. m., track 1 mile long and 100 feet wide. 5th, waterspout in Elkhorn Valley, Neb.; terrific wind and rain, Charleston, Ill. 6th, Chambersburg, Pa,, waterspout. 7th, peculiar hot, dry violent wind, Stockton, Cal. 9th, 5 miles north of Gainesville, Ga., heavy thunder-storm. 14th, Tornado at Rosemont, Dakota Co., and at Langdon, 12 miles

from St. Paul, Minn., about 8 p. m.; Northampton and Hadley, Mass. 17th, Memphis, tornado: this occured within an area of high barometer, and of prevailing southerly winds, at 7 p. m. a huge black mass advanced northeastward from a bank of clouds, with a low rumbling sound, as it passed over Memphis intense darkness and terrific noise prevailed, the Signal Service observer, standing on the roof of his building, was undisturbed, while objects, 25 or 30 feet distant to the SE of him, were destroyed; the violent wind occupied 3 or 4 minutes in passing him, and was followed by torrents of rain; the width of the belt of destruction was 200 yards or less, and its track about a mile long, trending from SW to NE. 18th, Fort Wayne, Ind., tornado, unroofing buildings; Mount Auburn, Ohio. 20th, Plattsmouth, Neb., and Carthagena, Ohio. 21st, St. Joseph, Mo., tornado, also throughout eastern Penna. 22d, North Platte, terrific sand-storm, much damage; Brookhaven, Miss., severe local storm; New Ulm, Tx., tornado. 23d, Plattsmouth, Neb., tornado. 24th, Leavenworth, Ks., destructive storm. 25th, Elmira, Ill., destructive local storm; Merom, Ind., 5 p. m.; Fort Wayne, Ind., tornado from the SW, unroofing buildings. 26th, Denison, Texas, southerly gale, considerable damage; Fort Whipple, Va. 27th, Fort Gibson, destructive gale. 29th, New Ulm, Minn., violent local storm, and tornado 6 miles W of Minneapolis. 30th, tornado passed E of St. Louis, extraordinary hail-storm at Lafayette, Ind.; Vevay, Ind., remarkably violent thunder-storm; storms in Morgan, Johnson, Shelby, Decatur, Rush, Wayne and Henry Counties, Ind., also near St. Louis, Mo., Richmond, Ky., and the central portion of Ohio.

An especial investigation of the tornado of the 4th, at Mt. Carmel, Ill., has been made by the Signal Service, of which the following is a preliminary report: The first intimation of the approach of the tornado was the gathering of threatening clouds in the west about 4:30 p. m., portending a severe thunder-storm. Suddenly two heavy clouds, of a black or dark blue color above, and dun-color beneath or on the sides, apparently disconnected themselves from the general mass of clouds, one moving from the northwest and the other from the southwest, the two converging and forming a junction about two miles west of the town. From these two clouds the tornado, which first struck the earth about one and a half miles west of the town, in a heavy piece of timber, developed. After traveling about a mile through the woods and over several farms, sweeping away fences, trees and houses which lay in its track, which was at this time 60 to 75 yards in width, it made an upward leap and cleared the ground for nearly half a mile, descending again to the ground just west of the town. With a terrific crash and deafening roar a whirling column swept centrally through the town, its general course, being WSW to ENE. Its transit through the town, a distance of nearly three quarters of a mile, could not have occupied more than half a minute, and may have been less, while the duration of the destructive blast at any one given point, from many accounts rendered did not exceed eight or ten seconds. In a track about 125 yards in width the destruction was complete. Houses were not only leveled with the ground but in some instances were entirely blown away and trees were uprooted and hurled for long distances. From 75 to one hundred yards on either side of the main track the destruction of buildings, etc., was only partial, growing gradually less toward the outer edges. After passing through the town the tornado crossed the Wabash river and plunged into the dense forest on the Indiana side, where it continued its work of destruction for four or five miles, when it apparently spread out and dissipated.

On the 24th a tornado and water-spout passed from west to east about two and a half miles north of Fort Lyon, (Las Animas,) Col. It was seen to originate to the northeast of the fort, forming from a dense black cloud, which was seen to throw down and then retract a long arm almost to the earth several times in succession, about 4 p. m. Finally, at 5 p. m., there was seen a rapid rotary motion, confined to a heavy, dark cloud in the northwest, when there set in to the west of it a rapid whirl, carrying up from the earth a vast column of dust, which advanced from the west and formed a continuous column with the current in the cloud. Suddenly a water-spout formed in the centre of the whirl; it passed across the prairie with a terrific noise; hail of a very large size descended with the water in the centre of the whirl; the violent wind unroofed the railroad depot, demolished a switch-house, &c. The track as examined the next day appeared to be about 500 yards wide. Pieces of ice fell "so large that they could not be grasped in one hand."

The storms of the 25th merit special attention. The weather maps of the 23rd, 24th and 25th show that southerly winds prevailed, with high temperatures, from Texas northward to central Missouri and eastward over the Ohio valley; these were on the 24th deflected into southwest winds, with low barometer No. IX, to the westward. Numerous local rains were reported on the 24th in Missouri. Between 11:30 p. m. of the 24th and 12:30 a. m. of the 25th a small area of cool northerly winds descended south and southeastward through Nebraska and Iowa, accompanied by heavy rain, which was very severe at North Platte at midnight, and extended to Dodge City, Kan., where light rain prevailed from 11:30 p. m. to 11:50 p. m., and to Omaha, where it continued until 7:15 a. m. During the afternoon of the 25th an additional flow of air from the north over Iowa and Wisconsin re-enforced that from Nebraska, and on the 4:35 p. m. map a belt from Lake Michigan to Dubuque, and thence to the southwest corner of Iowa, divided the southwest winds, (temperature 72° to 83°,) from the north winds, (temperature 59° to 72°.) By 11 p. m. of the 25th

this dividing belt had been pushed up northward to northern Wisconsin, central Michigan and Lake Erie. Meanwhile a remarkable series of local storms had occurred over portions of Iowa, Missouri, Illinois, Indiana and Ohio, in the region of warm southeast to southwest winds. These local storms individually moved from southwest to northeast, while the recorded times of their occurrence show that they were successively generated farther and farther to the south and east. At 11 a. m. of the 25th, according to a special dispatch to the Associated Press, storms were prevailing as far east as Peoria and Springfield, Ill., as far south as Springfield, Ill., and as far north as Madison, Wis.; in Iowa the weather was generally clearing, except in the eastern border. By 12:30 or 1 p. m. numerous storms had prevailed over Illinois; between 1 and 4 p. m. they had overrun Illinois; between 3 and 7 p. m. they had overrun Ohio, the last record being 7 p. m., in Guernsey co. A second set of storms occurred after 9 or 10 p. m. over these same States.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily weather Indications with the telegraphic weather reports for the succeeding twenty-four hours, shows a general percentage of omissions of 0.25 per cent., and of verifications of 86.5 per cent. Out of 3,591 predictions, 2,582, or 71.9 per cent., have been fully verified; 362, or 19.1 per cent., have been three-fourths verified; 454, or 12.6 per cent., have been one-half verified; 96, or 2.7 per cent., have been one-fourth verified; 97, or 2.7 per cent., have failed. The percentage for the four elements have been: weather, 94.5; wind, 85.2; temperature, 86.5; barometer, 79.6. The percentages of verifications by geographical districts have been: New England, 84.6; Middle Atlantic States, 9.14; South Atlantic States, 83.1; East Gulf States, 89.2; West Gulf States, 90.1; Lower Lakes, 86.6; Upper Lakes, 82.0; Tennessee and the Ohio valley, 86.1; Upper Mississippi valley, 85.0; Lower Missouri valley, 85.1.

Cautionary Signals.—During the month 74 Cautionary Signals have been displayed at stations on the Gulf and Atlantic coasts and the Lakes. Of these 59, or 80 per cent., were justified by subsequent high winds within one hundred miles of the stations for which they were ordered, and 15, or 20 per cent., were not justified so far as known. Sixty one instances of high winds, when no signals were displayed, have also been reported from these stations. Telegraphic communication with the North Carolina coast-stations has continued interrupted during the month.

NAVIGATION.

Stages of Water.—In the table on chart No. III are given the highest and lowest readings on the river-gauges for the month. It will be seen that the Red river remained moderately high during the month at Shreveport, the water reaching its highest stage on the 23rd. The Cumberland reached its maximum height at Nashville on the 17th, and was generally low during the month. The Ohio was lowest from the 3rd to the 9th, after which several small freshet waves, the results of heavy showers, passed down; the most important of these was that which reached Cincinnati on the 23rd and Louisville on the 26th. The Mississippi continued moderately high during the month from Keokuk down, although the water did not rise to any dangerous heights. The nearest approach to the "danger-line" was at Vicksburg on the 1st, but the river fell slowly at this point until the 10th. Above Keokuk no important changes occurred, and the channel continued sufficiently deep for navigation. The Missouri has remained very high at most points during the entire month. At Corinth, Mo., on the 13th, the water was higher than it had been since July 5th, 1873, flats, lumber-yards and smelting-works were flooded, extinguishing the fires in the latter, without doing serious damage. 10th, overflows at Independence, Kan. 11th, overflows in the Elkhorn in Nebraska and the Arkansas at Little Rock.

Ice-bergs were reported on the 9th lat. 43° 44′ N., long. 49° W.; on the 10th, lat. 43° 19′ N., long. 48° 53′ W.

TEMPERATURE OF WATER.

In General.—The temperature of water, as observed in rivers and harbors, is shown in the small table on chart No. II. The average temperatures have been lowest at Eastport, 39°; Marquette, 44.5. They have been highest at Augusta, 81°; Charleston, 78.5; Galveston, 78.5; Jacksonville, 77.5; Knoxville, 78; Mobile, 82.5; Montgomery, 81.5; Nashville, 78.5; St. Louis, 74.5; St. Marks, 77; Savannah, 78; Wilmington, 79.

Maximum and Minimum Temperatures.—The highest maxima have been: Jacksonville, 85°; Augusta, 86; Galveston, Mobile and Montgomery, 87. The lowest minima have been: Duluth, 45°; Marquette, 42; Eastport, 37.

Ranges of Temperature.—The least ranges have been: Eastport, 4°; Marquette, 5. The greatest ranges have been: Galveston, 17°; New London, 16; Jacksonville, 15; Omaha, St. Paul and Yankton, 14.

ATMOSPHERIC ELECTRICITY.

Thunder-storms were reported at stations as follows: 1st, Ill., Ind., Kan., Mass., Mich., Neb., Vt., Wis., Mo.; 2nd, Me., Ill., Ind., Kan., N. C., Ohio, Tenn., Vt., N. Y., Mo., N. H.; 3rd, Col., Ill., Ind., Iowa, Kan., Mich., N. J., N. Y., Ohio, Pa., Wis., Conn., Ind. Ty., Tex., D. C.; 4th, Va., Dak., Ill., Ind., Iowa, Kan., Mass., Neb., N. Y., N. C., Ohio, Tex., Mo., Ind. Ty., Me., Ky., Ga.; 5th, Md., Col., Ill., Ind., Mass., Neb., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Va., W. Va., Miss., Tex., D. C.; 6th, Md., R. I., Utah, Col., Conn., Dak., Ga., Ill., Iowa, Kan., Mass., Mo., Neb., N. H., N. J., N. Y., Pa., Va., N. C., Fla.; 7th, Ala., Col., Conn., Dak., Ill., Ind., Kan., Mass., Mo., Neb., N. J., N. Y., Ohio, Tenn., Tex., Iowa, Ind. Ty., Fla.; 8th, Va., Ill., Ind., Kan., Mich., Neb., Ohio, Tenn., Tex., Vt., Mo., N. C., W. V., Fla.; 9th, Va., Dak., Ill., Ind., N. C., Ohio, Pa., S. C., Tenn., Vt., Ga.; 10th, Dak., Fla., Iowa, Mo., Neb., N. H., N. Y., Wis., S. C., Ga., N. M.; 11th, Canada, Fla., Ill., Ind., Mich., Neb., N. Y., Ohio, Wis.; 12th, Ind., Iowa, Mich., Neb., N. Y., Ohio, Dak., Wis.; 13th, Ill., Ind., Kan., Mich., Miss., Neb., Ohio, Penn.; 14th, Minn., N. Y., Conn., Ill., Iowa, Mass., Mich., N. J., Ohio, Pa., R. I., Tex., Ga.; 15th, Ohio, Canada, Ill., Ind., Iowa, Mich., Miss., Neb., N. H., N. Y., N. C., Tex., Vt., Wis., Col., Dak.; 16th., Mich., Ohio, Canada, Conn., Dak., Ill., Ind., Me., Mass., N. J., N. Y., Pa., Vt., Iowa, Kan., Tex., Fla.; 17th, Minn., Ill., Ind., Iowa, Mo., Neb., N. C., S. C., Tenn., Va., Wis., Kan.; 18th, Ill., Ind., Iowa, Md., Mich., Neb., N. J., N. C., Ohio, S. C., Tenn., Va., Wis., Ga., W. Va., Fla., Col., D. C.; 19th, Conn., Dak., Ill., Ind., Iowa, La., Me., Minn., Mo., Neb., N. J., N. Y., N. C., Ohio, Pa., Tenn., Vt., Va., S. C., Tex., Fla., Ky., Ga.; 20th, Minn., Canada, Col., Ga., Ill., Ind., Iowa, Mich., Mo., Neb., N. J., N. C., Ohio, Tenn., Tex., Va., Wis., S. C., Kan., Ind. Ty., Fla., Dak.; 21st, Md., Conn., Dak., Del., Fla., Ga., Ind., Iowa, Kan., Mass., Mich., Mo., N. J., N. Y., Ohio, Pa., S. C., Tex., Vt., Va., R. I., Tenn., Ala., Ind. Ty., W. Va., Ky., D. C.; 22nd, Ala., Dak., Fla., Ga., Ill., La., Mass., Miss., N. Y., Pa., Tex., S. C., N. C., Neb., Minn.; 23rd, Minn., Dak., Fla., Iowa, Kan., Mo., Neb., Ga., Col.; 24th, Ala., Mich., Fla., Ill., Ind., Iowa, Kan., Mo., Ohio, S. C., Tenn., Ky., Dak., Minn.; 25th, Kan., Md., Dak., Ill., Ind., Iowa, Mich., Mo., Neb., Ohio, Mass., Va., Minn.; 26th, Md., Minn., Tex., Conn., Dak., Del., Ill., Kan., Mich., Mo., N. J., N. Y., N. C., Ohio, Pa., Tenn., Va., Mass., W. Va.; 27th, Dak., Ind., Iowa, Kan., Md., Mo., Neb., N. Y., Pa., Tex., Va., Wis., S. C., Tenn., N. C., Ala., Ga.; 28th, Dak., Fla., Iowa, Kan., Mo., Neb., N. Y., S. C., Va., Wis., Pa., Mich., N. C., W. Va.; 29th, Minn., Iowa, Kan., Mo., Neb., N. Y., N. C., R. I., Vt., Wis., Dak., N. H., W. Va.; 30th, R. I., Conn., Ill., Ind., Iowa, Mass., Mich., Neb., N. Y., Ohio, Pa., Vt. Wis., Mo., Fla.

Distant thunder or lightning was reported as seen from stations in the respective States as follows: 1st, Col., Ill., Ind. T., Kan., Tex., Ky., Vt. 2nd, Ill., Ind., Iowa, Ind. T., Kan., Me., Mo., N. H., N. Y., N. C., Ohio, Pa., Tenn., W. Va., Wis. 3rd, Ill., Iowa, Ind. T., Kan., Mo., Neb., N. Y., N. Mex. 4th, D. C., Dak., Ill., Ind. T., Iowa, Ky., Mo., Neb., N. C., Pa., Va. 5th, Ala., Col., Dak., Fla., Ga., Iowa, Kan., N. C., N. J., N. Y., Ohio. 6th, Col., Dak., D. C., Ill., Iowa, Kan., Me., Miss., Mo., N. Y., Va. 7th, Col., Ga., Ill., Iowa, Kan., Miss., Mo., N. Y., N. C., Tenn., Tex. 8th Ala., Fla., Ga. Ill., Iowa, N. J., N. C., Tenn., Tex. 9th, Ga., Mo., N. C., Tenn., Vt. 10th, Dak., Iowa, Ind. T., Kan., Mo. 11th, Iowa, Mich., Mo., N. Y., Wis. 12th, Iowa, Kan., Mo., Neb., N. Y. 13th, Col., Ill., Ind., Kan., Ky., Miss., N. C., Ohio, Tex. 14th, D. C., Ill. Iowa, Kan., Mass., Miss., Neb., N. H., N. J., N. Y., Pa., Wis. 15th, Dak., Ill., Ind., Iowa, Kan., Miss., Mich., N. H., N. Y., Tex, Vt., Wis. 16th, Dak., Ind., Iowa, Ky., Mass., N. H., N. J., N. Y., Ohio, Tenn., Vt., W. Va. 17th, Dak., Iowa, Kan., Ky., Mo., Minn., Ohio, Tenn., Va., W. Va. 18th, Ill., Iowa, Kan., Ky., Md, Mo., N. H., N. J., N. C., Tenn., Va., W. Va. 19th, Ala., Dak., Ill., Iowa, Kan., Ky., Minn., Miss., Mo., Neb., N. C., N. Y., Tenn. 20th, Col., Ga., Ill., Iowa, Kan., Mich., Miss., Mo., N. C., N. Y., Tenn. 21st, Dak., Ill., Ind., Ky., La., Mass., Miss., N. C., N. J., N. Y., Tex., Vt. 22nd, Dak., Kan., N. C., Tex. 23rd, Ala., Dak., Iowa, Kan., Ky., La., Mo. 24th, Iowa, Ind. T., Ky., Mich., Neb. 25th, Dak., Ill., Ind., Iowa, Ind. T., Kan., Ky., Mich., Mo., Neb., N. C., Pa., Tenn., Wis. 26th, Ala., Dak., Ind., Ind. T., Kan., Ky. N. C., N. J., N. Y., Ohio, Pa, Tenn., Tex., Va. 27th, Dak., Ga., Kan., Mass., Neb., N. C. 28th, Dak., Fla., Ga., La., Mich., Neb. 29th, D. C., Fla., Ga., Iowa, Kan., Me., Mich., Mo., Neb., N. C., N. Y., Ohio, Vt., W. Va. 30th, Ill., Iowa, Ky., La., Mass., Mich., Mo., N. Y., Ohio, Pa., Tenn., W. Va.

Auroras were observed as follows: 2d, Minneapolis, Minn. 3d, La Crosse. 4th, Mt. Forest, Can.; Jacksonville, Fla. 6th, Vevay, Ind.; Bismarck; Alpena. 7th, New Ulm, Minn.; Saint Paul; Minneapolis, Minn.; Rochester; Grand Haven; Washington, D. C. 8th, Bismarck. 10th, Westerville, Ohio. 11th Ft. Preble, Me.; Bangor; Gardiner, Me.; Burlington, Vt.; Minneapolis, Minn.; Boston, Mass.; Albany; Rochester; Oswego. 13th, Monticello, Iowa; Duluth; Bangor; Alpena. 14th, Rochester; La Crosse; West Charlotte, Vt. 17th, Bangor. 22d, Ft. Mackinaw; Atco, N. J.; St. Paul. 23d, Atco, N. J. 28th, Bangor.

Ground Currents.—Disturbances on lines of telegraph have been reported as follows; at Mason, Tex., on the 10th; at Pike's Peak, Col., an the 3d; at Santa Fe, N. M., on the 18th.

OPTICAL PHENOMENA.

Solar halos were observed on the 1st, Conn., Ky., Mass., N. Y., R. I., Tx.; 2d Canada, Conn., N. Y.,

Ohio; 3d, Ga., Neb., N. Y., Ohio, Tx.; 4th, Fla., Ala., Ill., Neb., N. C., N. H.; 5th, N. Y., 6th, Ill., Iowa, Ky., Neb.; 7th, Cal,. Dak., Minn., Neb., N. Y., Ohio; 8th, Conn., Del., N. Y., Ohio, S. C.; 11th, Dak., N. H.; 12th, Ala., Ill., Kan., La., Maine, Mass., N. H., N. Y., Pa.; 13th, Ill., Ky., Ohio, Tx.; 14th, Ind., Iowa, Kans., Maine, N. H., N. Y., Ohio; 15th, Ala., Mich., N. Y., Ohio; 16th, Ga., Ohio; 17th, Ill., N. J.; 18th, Mass., N. H., N. J., N. Y., Ohio, Wis.; 19th, Ill., Mass.; 20th, Conn., Mich., Ohio; 21st, Conn., Mass.; 22d, Ill.; 23d, Ill., Mass., N. H., N. Y.; 24th, Col., Mass., N. H., Conn., R. I.; 25th, Ky., Mich., N. H.; 26th, Ill., Kans., Ky., Mo., Neb.; 27th, Conn., Ill., Iowa, Ky., Maine, N. Y., Ohio, S. C.; 28th, Ill., Iowa, Maine, N. H., N. Y., Ohio, Wis.; 29th, Ill,, Ind., Kans., Mich., Ohio, S. C.; 30th, Ky., N. C., Ohio.

Lunar halos were observed on the 1st in Canada; 3rd, Ohio; 13th, Ind.; 16th, Ga., Mass., Pa.; 17th, Conn., Del., Ga., Ill., Ind., Md., Minn., Ohio, Va., D. C., 18th, Dak., Ga., Kan., Ill., La., Mass., Minn., Neb., Ohio, S. C.; 19th, Ill., Kan., Minn., S. C., Utah; 20th, Ill., La., Mich., Ohio; 21st, Ga., Ill., Iowa, S. C., Va.; 22nd, Ala., Ind., Iowa, Ill., Ohio, Tex., Va.; 23rd, Conn., Ind., Me., Minn.; 24th, Mich., S. C.; 25th, R. I.; 26th, Ala., Cal., Ga., Ky., Ohio; 27th, Ind.; 28th, N. Y.; 29th, Ohio; 30th, Ill., Ohio.

Mirage was observed at Barnegat N. J., and Atlantic City, N. J., on the 25th.

MISCELLANEOUS PHENOMENA.

Zoological.—Botanical.—Harvesting began as follows: *Barley*, 18th, Jacksonburg, Ohio; 19th, Vevay, Ind.; 30th, all in at Clarksville, Tex. *Oats*, 30th, all in at Clarksville, Tex.; 17th, heading out at Cresswell, Kan. *Rye*, 27th, Vevay, Ind.; 30th, Wappinger's Falls, N. Y. *Wheat*, 8th, Carbondale, Ill.; 12th, winter wheat heading out, Cresswell, Kan.; 17th, spring wheat heading out at Cresswell, Kan.; 17th, Alto Vista, Va.; 18th, Wappinger's Falls, N. Y.; 27th, Vevay, Ind., and Salem, N. J.; 28th, Jacksonburg, Ohio; 29th, Keokuk, Iowa; 30th, Clarksville, Tex., all in; 30th, Ringgold, beginning; 30th, Ruggles, nearly ripe. *Clover*, 1st, Wautoma, Wis., in bloom; 25th, Jacksonburg, Ohio. *Hay*, 18th, Salem, N. J.; 25th, Wappinger's Falls, N. Y.

Fruits.—Blooming and ripening, are reported as follows: *Blackberries*, in bloom, 5th, Cornish, Me.; 7th, Palermo, N. Y. *Cherries*, ripe, 15th, Wappinger's Falls, N. Y. *Currants*, ripe, 18th, Wappinger's Falls, N. Y.; Augusta, Ill., 28th. *Grapes*, blooming, 4th, Augusta, Ill.; 18th, Contocookville, N. H.; Concords ripe, in good exposures, 28th, Lake Charles, La. *Peaches*, ripe, 20th, Brookhaven, Miss. *Peas*, in bloom, 6th, Jacksonburg, Ohio; ripe, 7th, Wappinger's Falls, N. Y.; 15th, Starkey, N. Y.; 29th, Jacksonburg, Ohio. *Potatoes*, ripe, 29th, Jacksonburg, Ohio. *Mulberries*, ripe, 20th, Augusta, Ill. *Raspberries*, ripe, 26th, Wappinger's Falls, N. Y.; 27th, Augusta, Ill. *Strawberries*, ripe, 2d, Augusta, Ill.; 10th, Gardiner, Me., (two weeks early); 10th, West Charlotte, Vt.; 13th, Starkey, N. Y.; 18th, Contocookville, N. H.

Flowers and Trees.—*Daisies*, flowering, 14th, Somerset, Mass. *Locust tree*, in bloom, 5th, Somerset, Mass. *Roses*, in bloom, 3d, Wappinger's Falls, N. Y. *Syringia*, in bloom, 10th, Somerset, Mass. *Tulip tree*, in bloom, 3d, Richmond, Ind. *Water lilies*, in bloom, 5th, Fall River, Mass. *Yarrow*, in bloom, 17th, Palermo, N. Y.

Birds.—First seen as follows: *Cuckoo* 6th, and *Kingbird* 12th at Monticello, Iowa.

Insects.—*Chintz Bugs* were first seen, 1st, at Guttenberg, Iowa. *Caterpillars*, myriads at Sycotte station, near Chicago. *Bees*, 18th, Summit, Col. *Crickets*, 2nd, at Somerset, Mass. *House Flies*, 13th, Summit, Col.; 29th, Richmond, Ind. *Katydid*, 19th, Brookhaven, Miss. *Fire Flies*, 1st, Jacksonburg, Ohio; 7th, Augusta, Ill.; 8th, Freehold, N. J., Woodstock, Vt.; 10th, Palermo, N. Y.; 13th, Corning, Mo.; 14th, Linden, N. J.; 15th, Newark, N. J. *Colorado Beetle*, 14th, Linden, N. J., few; 20th, Riley, Ill., hatching; 24th, Starkey, N. Y.; 26th, Blooming Grove, Pa., few; 30th, Ringgold, Ohio, not destructive, Waltham, Mass., very destructive, Dunbarton, N. H., slight damage.

Locusts.—Special reports in reply to the circular of the U. S. Entomological Commission afford the following extracts: Freckericksburg, Tex., have visited this section regularly in April and September of each year since 1870, leaving after four or six weeks; were this year less numerous and destructive than formerly; left the first week of May. Eagle Pass, Texas, were numerous and destructive in September, 1873; eggs hatched in February and were destructive in May, 1874; another destructive swarm in September, 1875; eggs hatched in February and young ones left in May, 1876, doing little damage; no new swarms in 1877; a few hatched out from old eggs. Cambridge, Texas, a few stopped here in July, 1876, on their way southwestward; a few arrived May 7, 1877, and left within 24 hours. Indianola, Texas, locusts have never been seen hereabouts within 30 miles of the Gulf coast. Leavenworth, Kan., immense swarms of locusts arrived 10th to 15th of August, 1874, and left in about six days, followed by native grasshoppers; many young ones hatched out, and were full fledged 25th May, 1875: visited by very few in 1876. Dodge City, Kan., grasshoppers (locusts?) frequent from April to September, 1876; arrived May 21, 1877, at 10:30 a. m., and continued flying to the northeast until the 22nd, 5 p. m.; deposited no eggs. Denver, Col., was visited in 1864, '65, '66, '73, '74, '75, '76, (July 30th;) many young hatched in 1877, but died early. Breckenridge, Minn., visited in 1874, '75, '76; hatching rapidly May 15th to 31st, 1877. Corsicana, Texas, swarms arrived September 21, 1876, staying five days, and October 1st, staying nine days;

young hatched out 1877, from February 5th to 20th; departed between 1st and 21st of May. Special notes for June are as follows: Nebraska—Plattsmouth, not destructive but plentiful; North Platte, 15th, few flying north; Howard, hatching until June 15th, flying 20th to 30th, little damage. Dakota—Bismarck, 21st, 28th, 29th, flying NW. Colorado—Denver, 30th, very few have hatched. Kansas—Baxter Springs, 12th to 30th, flying NE., plenty remain in cold soils. Iowa—Vail, 30th, began to fly; Tabor, 30th, all gone. Missouri—Corning, plenty but not destructive. New Jersey—South Orange, 30th, all gone, little damage; Newark, 15th, slight damage; Vineland, 1st, plentiful, 14th, very few. D. C.—Washington, plentiful first ten days. New York—Starkey, 25th, seen; Wappinger's Falls, 1st, hatching, 13th to 18th, destructive, 26th, dying. Virginia—Alto Vista, 15th, all gone.

Balloon Ascensions.—Some information as to the condition of the atmosphere on June 18th and 19th, is given by the observations made during two balloon voyages starting from Nashville. The path of the balloon is shown on the accompanying Chart IV. The observations will be presented in full in the annual report of the Chief Signal Officer; they show that the bases of the cumulus clouds were formed at an altitude corresponding to the pressure of 25.50 inches at 5:40 p. m., but of 27.85 inches at 8 a. m., the temperature of their bases being, respectively, 79° and 78°. The highest point attained was at pressure 16.65 inches (where the temperature was 43° and the wet bulb thermometer read 36) on June 19th, 11:55 a. m., at which time the record at Nashville Signal Service station (altitude 504.2 feet) was 29.58, 86.5, 75.5, respectively.

Polar Bands.—Guttenberg, Nov. 22nd; Carthagena, Ohio, 1st, 3rd, 13th, 22nd, 29th; Denver, Col., 5th, 12th, 25th.

Sunsets.—The characteristics of the sky, as indicative of approaching fair or foul weather, have been observed daily, at sunset, at all Signal Service stations. The monthly means, from 97 stations, show that 74 doubtful cases, or blanks, were recorded, and that out of the remaining 2,832 cases 2,162, or 76.3 per cent. have been followed by the expected weather.

Forest fires prevailed in northern Michigan during the first 10 days of the month, being generally extinguished by rain on the 9th. Fire or smoke was also reported as follows: 1st, Greenville, N. C.; 3d, 4th, 5th, Kittyhawk, N. C., (in marshes;) 4th, Southington, Conn.; 6th, Hennepin, Ill.; 15th, 23d, Detroit, Mich.; 23d, West Waterville, Me.; 30th, Santa Fe, N. Mex., (for several days.)

Meteors were observed as follows: 1st, Davenport, Iowa; 3d, Carthagena, Ohio; 11th, Monticello, Iowa 12th, Mt. Auburn, Ohio; Louisville, Ky; Indianapolis and Fort Wayne, Ind., and Detroit, Mich.; 13th, Litchfield, Mich., (10 p. m.,) Bellefontaine, Ohio; 14th, Monticello, Io., Philadelphia, Pa.; 15th, Carbondale, Ill., (NW to SE) Mt. Sterling, Ill.; 16th, Waterburgh, N. Y.; 17th, Monticello, Io.; 19th, Merom, Ind.; 20th, Merom, Ind.; 21st, Leavenworth, Kan.; 24th, Davenport; 25th, Point Pleasant, La.; 26th, Point Pleasant, La.; 27th, Brook Haven, Miss.; 28th, Monticello, Io., Starkey, N. Y.; 29th, Point Pleasant, La., (zenith to SE. and meteoric shower,) Brook Haven, Miss., Freehold, N. J., (11 p. m. loud explosion,) Newark, N. J.; 30th, Summit, Col., Brook Haven, Miss., Salem, N. J., (10 p. m.,) Melissa, Tx., (8 p. m.,) Bloomfield, Wis., (10:40 p. m., followed by explosion in 3 to 5 minutes.

Zodiacal light.—Carbondale, Ill., 19th to the 28th. Savannah, Ga., 1st, 2nd, 3rd, 6th and 30th.

Earthquakes.—3rd, near Stanford, Ky., small local disturbance. 11th, volcanic disturbance 60 miles from Yuma, near Flowing Well, Cal. 18th, Milwaukee, 7:30 p. m., water in Lake Michigan fell two feet in one-half hour, and rose again much more quickly.

SOLAR PHENOMENA.

Sun-spots.—The following observations, made by Mr. D. P. Todd, upon the spots on the sun, have been kindly communicated by Rear-Admiral John Rodgers, U. S. N., Superintendent of the Naval Observatory:

June, 1877.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
11th, 5 p. m...	1	13±	0	0	0	0	1	13±	Spots very small and closely aggregated.
13th, 9 a. m...	0	0	0	0	0	0	0	0	
19th, 9 a. m...	0	0	0	0	0	0	0	0	
20th, 9 a. m...	0	0	0	0	0	0	0	0	
21st, 10 a. m...	0	0	0	0	0	0	0	0	
22nd, 10 a. m...	0	0	0	0	0	0	0	0	
23rd, { 8 a. m...	0	0	0	0	0	0	0	0	Several prominent groups of sizeable faculæ.
23rd, { 6 p. m...	1	2	0	0	0	0	1	2	
24th, 1 p. m...	0	0	0	0	0	0	1	2	
25th, 8 a. m...	0	3	0	0	0	0	1	5	
26th, 10 a. m...	0	1	0	0	0	0	1	6	
27th, 9 a. m...	0	0	0	0	0	0	0	0	Solar disk almost completely mottled with faculæ, many of them large.
29th, 6 p. m...	1	2	0	0	0	0	1	2	
30th, 9 a. m...	0	0	0	0	0	0	1	2	Several large faculæ; one of the spots is penumbral—quite without dark or well-defined nucleus.

Professor Tacchini reports to the Paris Academy of Sciences that, "on the 3rd, a small spot (the only one) appeared in the east, and gradually enlarged to 40s., by the 7th continuing of this size (some small spots which presently appeared with it ever changing) till it was near the border on the 13th. On the 14th, when projection and photography revealed hardly a trace of the group, the spectroscope discovered very lively chromospheric flames; higher up, several oblique fragments, evidently from violent eruption, eruption flames on the right, and lastly, a nebulous chromospheric mass, well illuminated and slightly divergent. There was constant commotion of matter."

NOTES AND EXTRACTS.

Prof. R. Wolf communicates to the Quarterly of the German Astronomical Association, (Vol. II, p. 87,) a report on his sun-spot investigations, as follows: "I have continued the observation of the condition of the solar spots (a work begun by me at the end of 1847 in extension of the work of Schwabe and Schmidt, and since then prosecuted uninterruptedly) at least once in every clear day, and very frequently many times and with different telescopes, and have thus obtained, for 270 days of the year 1876, the number g of visible groups and number f of their constituent spots and points, whence I have by the formula $r = k(f + 10\,g)$ computed the relative number r as first introduced by me in 1850. In this k indicates a certain factor, depending upon the observer and instrument; it is assumed as unity for myself using a magnifying power of 64 applied to a four-foot Fraunhofer refractor, and is for other observers or instruments to be deduced from corresponding series of observations. By supplying the record on days that were cloudy at Zurich from other observations made by Messrs. Weber in Peckeloh, Schmidt in Athens, Denza in Moncalieri, Tacchini in Palermo, I find r equal 11.3 as the mean of all the relative numbers for each day of the year 1876, and in connection with the mean relative numbers of the previous years I have the series:

YEAR	r	YEAR	r	YEAR	r	YEAR	r	YEAR	r
1867	7.3	1869	73.9	1871	111.2	1873	66.3	1875	17.1
1868	37.3	1870	139.1	1872	101.7	1874	44.6	1876	11.3

in which the periodicity of the sun-spot phenomena is clearly shown.

Prof. E. Loomis communicates to the American Journal of Science the following conclusions:

1. Areas of low barometer result from a general movement of the atmosphere towards a central area, and this movement is accompanied by a deflection of the wind to the right, which causes a tendency to circulate around the centre with a motion spirally inward.

2. This deflection to the right, which results from the earth's rotation, causes a diminished pressure within the area of this inward movement, and the pressure is still further diminished by the centrifugal force resulting from the circulation about a centre.

3. The amount of the barometric depression depends upon the force of the wind and the geographical extent of the revolving atmosphere. The effect of centrifugal force is not considerable except when the velocity of the wind approaches that of a hurricane. With a velocity of one hundred miles per hour, the depression due to centrifugal force may amount to about two inches; but in the winter storms of the middle latitudes with a velocity not exceeding 40 miles per hour, the depression due to centrifugal force seldom exceeds one or two-tenths of an inch. In these storms, three-quarters of the observed depression of the barometer is usually the effect of the earth's rotation; but in order that the depression at the centre may amount to as much as one inch, it is generally necessary that this system of circulating winds should prevail over an area nearly 2,000 miles in diameter.

[*To be continued in July Review.*]

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